# Feasibility Study For Wind Power Plant In Fulfilment Of NSPO Compliance For Indian Railways

**SUBMITTED BY**

***REMC LIMITED*** *(June 2021)*

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## 1.0 Background: -

**1.1 Renewable Energy-** In the past century, consumption of fossil fuel has caused substantial environmental damage. Major part of the electricity in the country is generated from fossil fuels such as coal and crude oil which has added to volumes of high concentrations of harmful gases in the atmosphere. Consequently, the resources of fossil fuels are depleting on one hand, while on the other side, this has led to ozone depletion and global warming. Therefore, alternative resources of energy have become quite relevant to today's world. These resources mainly include sun and wind which are available in nature in abundance. These are also known as non-conventional resources of energy.

The railways has taken a number of initiatives towards combating climate change and mitigation of global warming and if everything goes as planned, Indian Railways will be transformed into 'Green Railways' by 2030.The Ministry of Railways released a statement regarding this, stating some of the steps taken as part of the strategy to achieve net-zero carbon emission. The measures include electrification of the railways, improving energy efficiency of locomotives, trains, and fixed installations, acquiring green certification for stations/installations, fitting bio-toilets in coaches, and switching to renewable sources of energy. In this connection. Vision 2020 document of the Indian Railways states that the key target is to utilize at least 10% of its energy requirement from renewable sources.

## 2.0 Purpose/Objective: -

**2.1 Energy scenario on Indian Railways**- Indian Railways is the largest bulk consumer of electricity in India having consumption of about 13.85 billion units for Electric traction purposes with total energy bill of Rs.7669 Cr. (Source- ASS 2019-20 Statement 27 A, Col 72 & 73). Out of this energy 10.60 billion units are procured through open access as deemed licensee while the remaining is procured as 'Consumer'. Though, Indian Railways is an organization with inbuilt structure to discharge the social obligations of the nation, the Electricity Boards have taken the approach of fixing unreasonably high traction tariffs and keep on increasing the tariff every year.

Indian Railways being a significant consumer of energy, identifying cost-effective options to achieve and realizing an energy system with least environmental impacts is essential.

**2.2 Need for Green Energy (Renewable power): -**In order to contain the increase in tariff, IR has taken various steps including the use of traction energy through open access as deemed licensee. As on date, IR has tied up 1417 MW power for traction in Open Access as Deemed licensee in states like MP, Rajasthan, Punjab, Haryana, Delhi, Jharkhand, UP, Bihar, Maharashtra, Karnataka and Gujarat utilising about 1400 MUs per annum. In these states the trend of increase in traction tariff is not only restricted but the tariff has also become quite competitive. However, one of the requirements in open access is to have a part of total quantum from renewable sources called SPO (Solar Purchase Obligation) and NSPO (Non-Solar purchase obligation). The RPO requirement is calculated as per the prevailing rate of State Regulators and as a function of energy consumption under open access in the state. For example, the energy consumption in OA in the year 2019-20 in Gujarat is 663.67 MUs and the rate of NSPO of Gujarat regulator is 8.05% i.e. 663.67x8.05%= 53.42 MUs are required against NSPO. Thus, the installed capacity for supplying the NSPO in Gujarat works out to be as 53.4/(365x24x22%(plf)) = 28 MW. Accordingly, based on the energy utilization during FY 2019-20 & estimated RPO as per the Regulators, the requirement of SPO and NSPO in these states is enclosed at Table 1 below:

**Table-1: Details of NSPO requirement in Open Access states**

| State | Existing tied-up quantum (MW) | Annual Energy Cons. FY 2019-20 (MUs) | NSPO % in States | | | Already Installed Capacity of IR | Net surplus shortfall # |
|---|---|---|---|---|---|---|---|
| | | | % | MUs | MW | | |
| (1) | (2) | (3) | (4) | (5)@ | (6)$ | (7) | (8) |
| Bihar | 100 | 663.67 | 6.75 | 44.8 | 23 | | -23 |
| DVC | 110 | 863.52 | 10.25 | 88.5 | 46 | | -46 |
| Delhi | 14 | 106.26 | 0.00 | 0.0 | 0 | | 0 |
| Gujarat | 90 | 663.67 | 8.05 | 53.4 | 28 | | -28 |
| UP ISTS | 105 | 872.97 | 5.00 | 43.6 | 23 | | -23 |
| UP-STU | 130 | 1226.07 | 5.00 | 61.3 | 32 | | -32 |
| Haryana | 53 | 338.08 | 3.00 | 10.1 | 5 | | -5 |
| MP | 270 | 2075.71 | 8.00 | 166.1 | 86 | | -86 |
| Maharashtra | 330 | 2568.74 | 11,50 | 295.4 | 153 | 50.4 | -102.6 |
| Jharkhand | 70 | 444.93 | 5.00 | 22.2 | 12 | | -12 |
| Rajasthan | 65 | 398.75 | 8.30 | 33.1 | 17 | 26 | +9 |
| Punjab | 35 | 86.22 | 5.5 | 4.7 | 2 | | -2 |
| Karnataka | 45 | 260.27 | 12.0 | 31.2 | 16 | | -16 |
| Total (All India) | 1417 | 10569 | - | 854.6 | 443 | 76.40 | 366.6 **(Say 400MW)** |

# 21 MW capacity installed in TN in consumer mode,
@ (5)= (4)/100*(3), $= (5)/(365*24*22%plf)*1000

SPO is met with the power procured from solar plants and wind power is cheaper when compared with the various other sources of NSPO. As per Regulatory norms for fulfilling NSPO, the total current requirement of Indian Railways is of the order of 443 MW against which only 76.40 MW wind power plants are existing in open access states besides 21MW in Tamil Nadu in consumer mode thereby leaving a shortfall of about 366.60, Say 400 MW.

## 3.0 Current Projects of IR

### 3.1 REMC LTD and its association towards the Objective: -

In order to achieve the objective of the Mission, REMCL has been mandated by IR for the services towards: -

(a) To reduce carbon footprint of Indian Railways
(b) To substitute fossil fuel-based power with renewable energy progressively.
(c) To procure renewable power at economical tariff.
(d) To fulfil Renewable Purchase Obligation of Railways

IR has since commissioned two pilot solar power projects of about 2 MW each for feeding solar power directly to 25 kV AC traction system and based on the experience gained, Solar Plants along the Railway Track and on large vacant land parcels of IR upto a capacity of 3000 MW for Traction purpose is in tendering stage.

**3.2 REMC LTD involvement in procurement of Wind power: -**IR through its PSU, REMCL have taken necessary steps for arranging sufficient solar power (SPO requirement) through bidding in developer & Capex model, however steps taken for requisite wind power (NSPO requirement) would only cater to a part of such requirement.

### 3.3 Mandate for implementation of Wind Power & Execution so far

**3.3.1 The Mandate: -** Railway Board vide letter dtd. 24.01.2014 mandated REMC Ltd for setting up of a 157.5 MW capacity windmill plant. Accordingly, a MoU was signed between the Ministry of Railways (Railway Board) and REMC Ltd on 30.01.2014 for execution of the wind projects on a debt equity ratio of 70:30 and project equity of 30% shall be shared by Railways and REMCL.

**3.3.2 The Implementation: -** Out of total capacity of 157.5 MW, REMC Ltd has executed a 26 MW windmill plant in Rajasthan (Owned by REMC Ltd). Besides, a 10.5 MW windmill plant in Tamil Nadu (Owned by SR) has been installed whose capacity is being utilised for traction purpose in the Consumer mode. Till date, a total of 76.4 MW wind plant capacities are tied up in various models as under: -

**3.3.2.1 Supply of wind power from 26 MW wind mill of REMCL (Capex Model)-** Power is supplied intra-state in Rajasthan for traction purpose on landed tariff basis.

**3.3.2.2 Procurement of 50.4 MW Wind Power in Maharashtra in Developer Model :** IR (CR) is taking power as Deemed Licensee in Maharashtra and accordingly is liable to comply with Renewable Purchase Obligations (RPO) which comprises of Solar & Non-solar Purchase obligations (SPO/NSPO). On the request of Central Railway, REMCL has facilitated the procurement of 50.40 MW of wind power for fulfilment of their RPO compliance towards part NSPO requirement (wind power) as per MERC regulations through tariff based bidding in Developer Mode without any investment from Railways. The successful bidder M/s NVVNL shall supply 50.4 MW wind power to Central Railways through an already commissioned plant (on 26.03.17) owned by M/s NALCO at Jat Sangli in Maharashtra. The power flow was commenced in June 2019.

**3.3.2.3 Procurement of 6 MW Wind Power in Maharashtra in Developer Model: -**Railway Board mandated REMCL for implementation of wind power procurement for non-traction purposes in various states. Accordingly, REMCL on behalf of CR floated a tender for procurement of 6 MW wind power in the state of Maharashtra on tariff-based bidding model without any investment from Railways. After evaluation, REMCL issued a letter of award (LOA) to M/s Inox Wind Infrastructure Services Ltd. Power Purchase Agreement (PPA) between Wind Power Developer (WPD) and CR for 25 years was signed on 02.05.2018. Power generated from this plant shall be used at 5 Nos. non-traction loads points (4 of CR & 1 of SECR) in Maharashtra. The 6 MW wind power plant is located at Sangli (Maharashtra) and was commissioned on 05.01.2019.

## 4.0 Methodology

The wind power projects are installed in the country commercially, based on techno economic feasibility of the site. During the last five years, approx. 14 GW wind capacity has been added. The Government issued 'Guidelines for Development of Onshore Wind Power Projects' on 22 October 2016 with an objective to facilitate the development of wind power projects in an efficient, cost effective and environmentally benign manner taking into account the requirements of project developers, state and national imperatives.

Government (MNRE) have also issued 'Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Wind Power Projects' on 8th December 2017, followed by amendments there upon, with an objective to provide a framework for procurement of wind power through a transparent process of bidding including standardization of the process and defining of roles and responsibilities of various stakeholders. Based on these guidelines SECI has been floating tenders and awarding the contracts since 2017. On these guidelines itself and based on SECI's tenders REMCL has also awarded the projects of 50.4 MW for CR.

## 5.0 Potential windy States in India

The National Institute of Wind Energy (NIWE), Chennai has estimated the gross wind power potential of the country as 304 GW and 695 GW at 100 meter and 120 meter above ground level, respectively.

**5.1 Wind Power in various States-** India has got an ambitious plan to exploit in full, the present estimated wind energy potential in the country. About 37 GW has been exploited till date while 267 GW is yet to be exploited.

**5.1.1** The State-wise position of Wind Power potential vis-a-vis Installed Capacity in India is tabulated below in Table-2. It may be seen from table-2 that among the windy states, there is ample capacity which is yet to be installed and it will therefore be appropriate to consider windmill installation in these windy states.

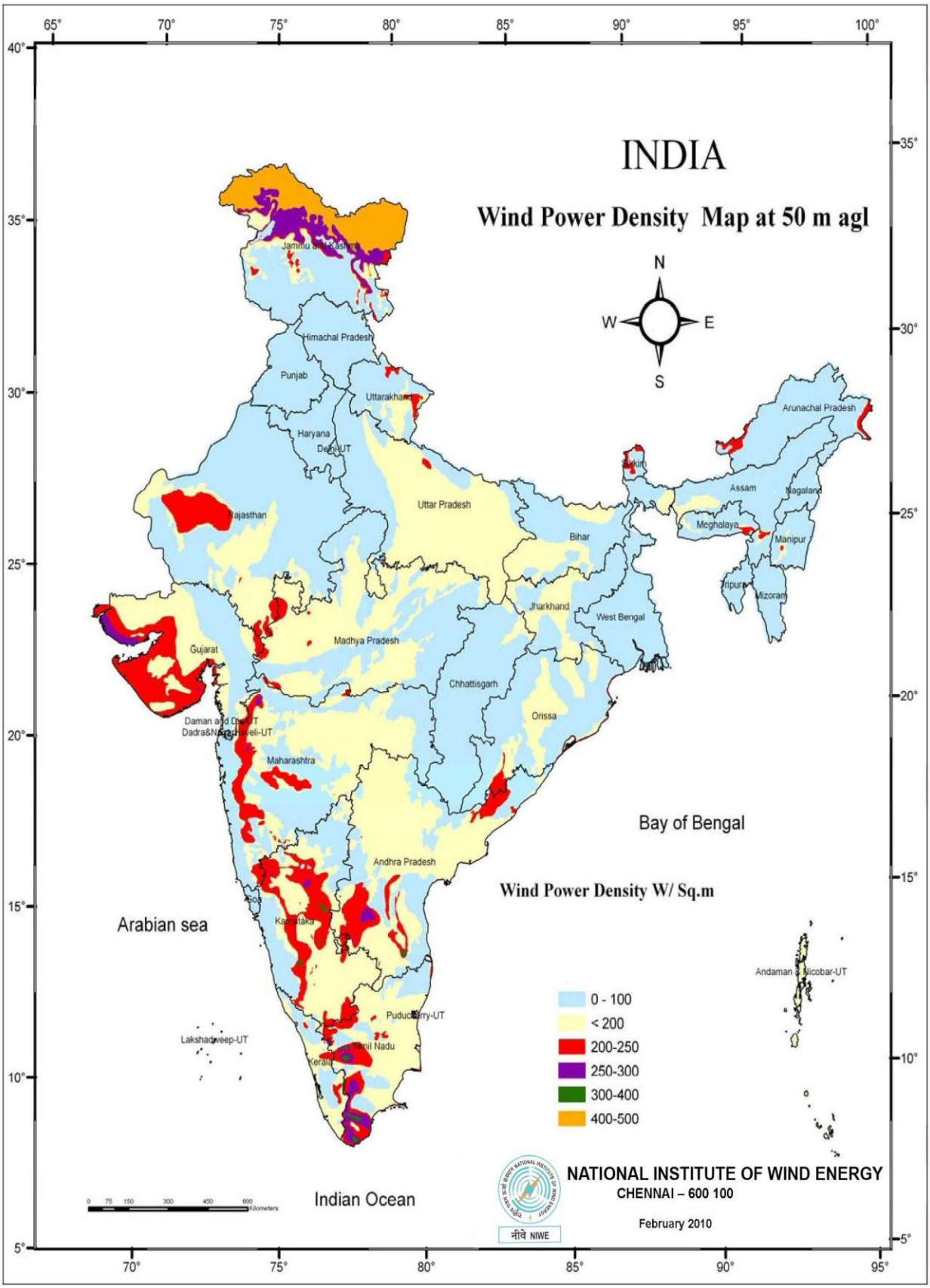
**Table-2**

**Wind Power potential vis-a-vis Installed Capacity in India**

| State | Gross Potential 100 m ht (MW) | Total Installed Capacity (MW) till 31.10.2019 | Balance unutilised potential (MW) till 31.10.2019 |
|---|---|---|---|
| **Windy States** | | | |
| Andhra Pradesh & Telangana | 44228.60 | 4220.55 | 40008.05 |
| Gujarat | 84431.335 | 7203.77 | 77227.565 |
| Karnataka | 55857.36 | 4753.40 | 51103.96 |
| Kerala | 1699.56 | 62.50 | 1637.06 |
| Madhya Pradesh | 10483.68 | 2519.89 | 7963.79 |
| Maharashtra | 45394.34 | 4794.137 | 40600.203 |
| Rajasthan | 18770.49 | 4299.72 | 14470.77 |
| Tamil Nadu | 33799.65 | 9231.774 | 24567.876 |
| **Other states** | 9280 | 4.30 | 9275.70 |
| Total (All India) | 303945.05 | 37090.03 | 266854.974 |

(Source- NIWE, capacities at 100 M height assuming reconditioning/ decommissioning/ recommissioning of existing plants at various heights)

**5.1.2 Wind Power Density Map of India:-** A wind power density map is placed below:-



## 6.0 Tariff of Conventional Energy on IR

*Energy charges & State-wise Tariff - Year 2019-2020*

| State | Energy consumed in million units kWh (2019-2020) | Bill paid in million Rs. (2019-2020) | Average cost of energy in Rs/kWh.(2019-2020) |
|---|---|---|---|
| ANDHRA PRADESH | 1574.28 | 8567.55 | 5.44 |
| BIHAR | 900.27 | 5458.4 | 6.06 |
| CHHATTISGARH | 976.64 | 4905 | 5.02 |
| DELHI | 104.96 | 475.15 | 4.53 |
| GUJARAT | 654.87 | 3727.31 | 5.69 |
| HARYANA | 399.74 | 2301.86 | 5.76 |
| JAMMU & KASHMIR | 22.36 | 146.76 | 6.56 |
| JHARKHAND | 1450.63 | 7613.96 | 5.25 |
| KARNATAKA | 141.6 | 803.99 | 5.68 |
| KERALA | 305.21 | 1905.04 | 6.24 |
| MADHYA PRADESH | 2127.69 | 10484.01 | 4.93 |
| MAHARASHTRA | 2621.18 | 14946.4 | 5.7 |
| ORISSA | 1454.9 | 9353.1 | 6.43 |
| PUNJAB | 250.52 | 1924.46 | 7.68 |
| RAJASTHAN | 390.48 | 1804.05 | 4.62 |
| TAMIL NADU | 971.81 | 8297.11 | 8.54 |
| TELANGANA | 701.2 | 3938.24 | 5.62 |
| UTTAR PRADESH | 2046.66 | 12051.72 | 5.89 |
| UTTARANCHAL | 29.9 | 173.2 | 5.79 |
| WEST BENGAL | 1551.48 | 11421.26 | 7.36 |
| GRAND TOTAL | 18676.38 | 110298.57 | 5.91 |

*Source:- Rail Saver*

## 7.0 Major Wind power developers

IR had explored the possibilities of procuring wind power through tariff based bidding in June 2016 when ML had called prospective wind power plant developers in a meeting to discuss various points and aspects of IR requirement like landed tariff, wheeling & transmission losses/charges, single tariff vs tariff in slabs of five years etc. Following Developers had participated in that meeting:-

(i) M/s Suzlon Energy Pvt. Ltd
(ii) M/S Inox Wind Ltd.
(iii) M/s Siemens Gamesa
(iv) M/s Regen power

Since then, the tariff based bidding has been well established as SECI has implemented ano of projects wherein following prospective bidders/ Developers has emerged:-

(1) M/s Renew power venture Pvt. Ltd
(2) M/s Orange Sironj Wind Power Pvt. Ltd.
(3) M/s Inox wind Infrastructures Ltd
(4) M/s Green Infra wind Energy Ltd
(5) M/S Adani Green Energy (MP) Ltd/Adani Renewable energy Park (Gujarat) Ltd.
(6) M/s BLP energy Private Ltd
(7) M/s Spring Energy Pvt. Ltd
(8) M/s Hero Wind Energy Pvt. Ltd
(9) M/s Regen powertech Pvt. Ltd
(10) M/s Torrent power Ltd.
(11) M/s Alfanar Company
(12) M/s Betam Wind Energy Pvt. Ltd.
(13) M/S BLP Energy Pvt. Ltd
(14) M/s Orange Saundatti Wind power Pvt. Ltd.
(15) M/S Miytrah energy (India) Pvt. Ltd
(16) M/s Colossal power Pvt. Ltd.
(17) M/s Sitac Kabini renewables Pvt. Ltd.
(18) M/s Ecoren Energy India Pvt. Ltd
(19) M/s Renew wind Energy (Karnatak two) Pvt. ltd.
(20) M/s Srijan Energy system Pvt. Ltd.
(21) M/S Powerica ltd
(22) M/s SBESS sServices Projectco two Pvt Ltd
(23) M/s Fasten Power Pvt. Ltd
(24) M/s Avikaran Energy India Pvt. Ltd.
(25) M/s Ostro Energy Pvt. Ltd
(26) M/s Spring Vaayu Urja Pvt. Ltd.
(27) M/s CLP India Pvt. Ltd
(28) M/s Adani renewable energy Holding Fifteen ltd.
(29) M/s Ayana renewable power Six Pvt. Ltd.
(30) M/s Evergreen Power Mauritius Pvt. Ltd.
(31) M/S JSW Future Energy Ltd.
(32) M/s Azure power India Pvt. Ltd
(33) O2 Power SGE PTE Ltd
(34) Shirdi Sai electricals Ltd.
(35) M/s AMP Energy Green Pvt. Ltd
(36) M/s Tunga Renewable Energy Pvt. Ltd
(37) M/s Renew vyan Shakti Pvt. Ltd.
(38) M/s Halvad renewables Pvt. Ltd.

## 8.0 Trends of Wind power Tariff

Following is the trend of Tariff (ex-plant bus) in SECI's various tenders since 2017 and also REMCL's tender:-

### 8.1 SECI's awarded tariff

| SN | Month & Year of bidding | Per unit Tariff in Rs (ex-bus) |
|---|---|---|
| 1 | February, 2017 | 3.46 |
| 2 | October, 2017 | 2.64 |
| 3 | February, 2018 | 2.44 |
| 4 | April, 2018 | 2.51, 2.52 |
| 5. | Sept, 2018 | 2.76, 2.77 |
| 6. | February, 2019 | 2.83 |
| 7 | May, 2019 | 2.79, 2.81, 2.82, 2.83 |
| 8 | August, 2019 | 2.83, 2.84 |
| 9 | March, 2021 | 2.77, 2.78 |

### 8.2 REMCL awarded tariff

| SN | Month & Year of bidding | Per unit Tariff in Rs (ex-bus) |
|---|---|---|
| 1 | Dec, 2018 | 2.92 |

## 9.0 Challenges in wind power projects:-

**9.1 In Traction (for 66 kV and above):**- Although, procurement of wind power on tariff-based bidding model without any investment from Railways, however in the present era of steep downwards trend of tariff and involvement of PPA for long term for a period of 25 years sometimes becomes unviable. But, since the present requirement of IR is against NSPO which is mandatory for procurement of power under OA and the tariff being discovered through open bidding, IR in any case has to go for the procurement for long term gains and to avoid penalty on account of non-compliance of RPOs. Hence, such procurement against NSPO is inevitable.

**9.2 In non-Traction (below 66 kV):-** There are no. of challenges and constraints faced in taking wind power at non-traction load points of IR through open access as consumer of state discom. Hence, taking wind power on non-traction load points is not advised presently.

## 10.0 Other Items: -

### 10.1 Transmission charges waived till June 2023

The Tariff Policy, Ministry of Power had issued orders 23/12/2016/-R&R dated 30 Sept 2016 and 14 June 2017 had waived ISTS charges and losses on electricity generated from solar and wind sources of energy for sale to distribution companies for compliance of RPO. The Ministry in its order dated November 2019, had extended the waiver date from date March 31, 2022, to June, 2023.

The Ministry of Power (MoP) has notified that it has extended the waiver of inter-state transmission system (ISTS) charges and losses on the supply of power generated from solar and wind power projects until June 30, 2023. In its notification, the Ministry added that no ISTS charges would be levied for 25 years from the date of commissioning of the power plants for the supply and sale to entities having renewable purchase obligations (RPO), irrespective of whether this power is within RPO or not, provided that in case of distribution licensees (Discoms), the power has been procured competitively under the guidelines issued by the Central Government.

### 10.2 Optimisation and rightsizing the proposed capacity of plant:

CERC vide its "Detailed procedure for 'Grant of connectivity to projects based on renewable sources" under the clause 4 stipulates under 'Eligibility' that:-

*'Application for Stage-1 connectivity can be made by:*

*(i) An entity intending to set up generation projects based on renewable energy sources including hybrid projects on renewables and storage for a capacity of 50 MW or above:*

*(ii) An entity acting as Lead Generator on behalf of constituting entities intending to set-up generation projects based on renewable energy sources including hybrid projects on renewables and storage and seeking connection from CTU at single connection point, individually having less than 50 MW installed capacity or above.*

In order to have flexibility in evacuation of power in any of the above OA states, while it is advisable to have ISTS connected plant as per the above norms of CERC but at the same time if the requirement is within the state in which renewable source is there, the connectivity with STU is sufficient. It is accordingly suggested that a plant capacity of 50 MW ISTS or STU connected is considered as optimum size as per the requirement of IR .

## 11.0 Recommendation:

- In view of the abundance of resources of wind power and the requirement of IR against NSPO in OA states, it is proposed to take up power procurement through tariff based bidding from wind power project developers up to capacity of 400 MW in phased manner at TSSs which are connected at voltage level 66 kV and above.
- It is proposed to consider a sizable capacity of wind mill plant in Developer mode in either of the windy states having open access (I.e. Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan). Presently, tender be invited for a capacity of 50 MW (Phase-I) during the year 2021-22 for which a proposal has been submitted to RB on 10.03.2021.
- It is also proposed that the plant be either ISTS or STU connected as per the requirement of IR
- The project is envisaged to be implemented in Build, Own & Operate (BOO) model. Bidders will be selected through open bidding with reverse auction through e-tendering based on the lowest quoted tariff per unit (kWh) for 25 years.
- Indian Railways shall enter into a Power Purchase Agreement (PPA) with the successful bidder for purchase of electricity generated from windmill plant. The power generated from this wind mill plant shall be utilized for traction purpose.
- Transmission charges & losses, wheeling charges & losses and any other charges as applicable in state are to be borne by Indian Railways.
- Open access on TSSs to/from Central /State authorities shall be processed & coordinated by Zonal Railway utilising the wind power generated by the plant. However, responsibility of getting connectivity and other approvals from the Central/State government or other utilities as applicable shall be of developer.

## 12.0 Way forward:

It is to be proposed that a capacity of 400 MW Wind power be implemented in phased manner as under:-

| Phase | Quantum | Status | Proposed Year of implementation (issue of LOA) | Remarks |
|---|---|---|---|---|
| I | 50 MW | Proposal sent to RB (10.03.2021) | 2021-22 | Early approval of RB required. |
| II | 150 MW | To be planned later on after approval of Phase-I | 2022-23 | Shall be planned in consultation with RB based on NSPO. |
| III | 200 MW | To be planned after approval of Phase-II | 2023-24 | |
| **Total** | | | **400 MW** | |